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APRIL, 1931

DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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GEOPHYSICAL ABSTRACTS

NO. XXIV

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DEPARTMENT OF COMMERCE -- BUREAU OF MINES

GEOPHYSICAL ABSTRACTS[1]

No. 24

Compiled by Frederick W. Lee[2]

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1. GRAVITATIONAL METHODS

(121) IMPROVED METHODS IN GRAVITY DETERMINATIONS

By A. C. Longden

Transactions of the Illinois State Academy of Science, vol. 22, 1930, pp. 339-348.

After a brief discussion of generally used methods of the absolute determination of gravity by means of a pendulum, the author describes his new method by which some defects of the old methods, with regard to accuracy of measurements, can be avoided.

Both simple pendulums and compound reversible pendulums may be used in the improved method, in which the length of a pendulum is compared with that of a carefully prepared invar rod. The method is explained in detail. Illustrations of the apparatus are given.

At the end of the article Longden observes that although knife edges were assumed in the description of his pendulum, actually he was using well-hardened, highly polished steel rollers 3 or 4 millimeters in diameter. The preference for roller bearings in place of knife edges is explained.

In conclusion, the author says that in order that the length of pendulum shall remain constant the rods should have an extremely low coefficient of linear expansion. For this reason invar, nickel-steel alloy which expands only about one part in a million for a change of temperature of 1°, is used; but invar is strongly magnetic, and the pull of the earth as a magnet is added to the earth's gravitational pull in the pendulum.

To avoid this complication the author recommends the use of fused quartz, which has an even lower coefficient of expansion than invar and is entirely free from magnetic effect. In lieu of fused quartz, well-selected pyrex tubes give very satisfactory results.

The methods described in this paper relate to absolute determinations of gravity and not to the relative work carried out with the half-second pendulums.--W. Ayvazoglou.

(122) ISOSTASY AND THE FIGURE OF THE EARTH

By W. Heiskanen

American Journal of Science, vol. 21, No. 121, 1931, pp. 39-50.

In this article Heiskanen discusses Hopfner's opinions on isostasy and the figure of the earth expressed in the form of the following statements:

1. Helmert's, Berroth's and Heiskanen's triaxial ellipsoids are due solely to the isostatic method of reduction and thus have no real relation to the facts of the case.

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2. Because in isostatic reductions the displacement of mass takes place, which in turn causes warping of the geoid, the isostatic reduction can not be used in determining the figure of the earth.

3. The observed gravity anomalies can be explained solely by means of the warping of the geoid (Bruns's term) without the principle of isostasy.

4. The elevation and depression of the geoid referred to the spheroid are vastly greater than hitherto has been supposed.

5. The existence of isostatic compensation is at least questionable.

Heiskanen considers in detail in this article the reduction of gravity observations and the significance of the gravity formulas derived from reduced gravity values, thus trying to prove that Hopfner's arguments are incorrect.

A list of references is added.--W. Ayvazoglou.

(123) PROFESSOR P. M. NIKIFOROV'S FORMULAS FOR CONSIDERATION OF THE INFLUENCE OF THE TOPOGRAPHIC RELIEF UPON TORSION-BALANCE MEASUREMENTS (IN RUSSIAN)

By N. Samsonov

Bulletin of the Geological and Prospecting Service, U.S.S.R., Leningrad, vol. 49, No. 6, 1930, pp. 67-70.

In this article the author gives a critical estimation of formulas concerning calculation of the correction for topographic relief, as proposed by some scientists (Eötvös, Schweidar, Nikiforov, Numerov, Haalck, and others). From examination of Nikiforov's formulas Samsonow draws the following conclusions:

1. Nikiforov assumes that for values of $\rho \geqslant 20$ m. the expression $\left(\frac{c-x}{\rho}\right)^2$ is small; Eötvös admits this simplification only for $\rho \geqslant 100$ m.

2. The condition $\rho \geqslant 20$ m. is not taken into consideration, and numerical coefficients are given for $\rho \geqslant 4$ m.; this causes an error up to 45 per cent in calculations of the correction.

3. Nikiforov does not make a difference between the curve of the relief Z (ρ) and the expression $f[\rho, Z(\rho)]$ under the integral sign, therefore he erroneously considers the relief-curve Z (ρ) as a curve of the second order.

4. In the derivation of the formulas Nikiforov assumed that a relief up to 20 m. can be considered an inclined plane; this is not possible in practice.

Nikiforov's method is, in the opinion of the author, a step backward if compared with Eötvös's formulas; therefore, owing to the errors admitted, it can not have either theoretical or practical importance.--W. Ayvazoglou.

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(124) GRAVIMETRIC AND SEISMIC EXPEDITION TO CENTRAL ASIA

By D. Mushketov and P. Nikiforov

Comptes Rendus de l'Académie des Sciences de l'U.S.S.R., Leningrad, No. 22, 1929, pp. 499-502.

In this article the authors describe the gravimetric and seismic expedition to Ferghana (Central Asia) in the autumn of 1928. Ferghana, a province of most intensive seismic activity, is known for quite exceptional (as to numeric values) negative anomalies of intensity of the force of gravity (up to 0.358 cm./sec.^{2}), as well as for considerable anomalies in its direction. That region is also known for its tectonic phenomena, which have resulted in strongly developed folds, faults, thrusts, and overthrusts. Thus the extensive study of this region would have exceptional scientific and practical value.

The expedition consisted of three parties, working with pendulums, torsion balances, and seismographs, respectively.

In this article the authors give only the results of the study of pendulum observations. In a table, two columns (8 and 9) contain the theoretical values of gravity at the stations named in column 1, as computed from Helmert's formula corrected for elevation (γ) and for topography and compensation (γ_1), according to Hayford's formulas.

The observed values of g are given in column 10 and in columns 11 and 12 the free air ($\triangle g = g - \gamma$) and Hayford's ($\triangle g_1 = g - \gamma_1$) anomalies, respectively, are given.

Both anomalies $\triangle g$ and $\triangle g_1$ have a very smooth and consequent course, reaching the maximum of absolute value in the center of the Ferghana Valley, the extreme values being very high, namely: $\triangle g = -0.197$ and $\triangle g_1 = -0.112$ cm./sec^2.

Both anomalies are negative on the whole stretch, save for $\triangle g_1$ at Shakhimardan. In the north, at the entrance into flat steppes, g is approaching its normal value. The authors conclude: "Thus, in the area of the Ferghana depression, a lack of compensation is established quite positively, which involves the tendency of that portion of the earth crust to vertical displacement upward, the latter circumstance being the cause of numerous strong earthquakes. As to the origin of the Ferghana depression we are led to conclude that it was formed as the result of squeezing of the earth crust, the sial-masses being pressed into a denser layer underlying the crust."--W. Ayvazoglou.

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(125) DIE BESTIMMUNG DER GEOIDUNDULATIONEN AUS SCHWEREMESSUNGEN.

(DETERMINATION OF GEOID UNDULATIONS FROM GRAVITY MEASUREMENTS)

By Karl Jung

Gerlands Beiträge zur Geophysik, vol. 29, No. 1, 1930, pp. 29-64.

According to discussions published previously in this journal the isostatic gravity anomalies can not be used directly for determination of the geoid undulations, as the moving of masses on which the reduction is based causes displacement of the potential surface.

Two methods are developed to avoid this inconvenience. The effect of the isostatic reduction upon the position of the potential surface is calculated and represented in a series of spherical harmonics. The negative result of this potential surface displacement (called "Isostatische Geoidundulation"), "U", represents undulation of the geoid in case of purely isostatic structure of the earth's crust. "U" and correction $K^{(is)}$, which must be added to the result if the isostatic anomalies are applied directly, are calculated by using spherical harmonics of the first 5°; maps representing them are added.

The method given by Hopfner in this journal does not result in the geoid undulations sought but in undulations for a potential surface, which includes all masses on which gravity has the same distribution as on the real geoid.

A correction must be added on account of the masses lying outside of the geoid. This correction, $K^{(H)}$, is also calculated by using spherical harmonics of the first 5°; maps are added.

It is evident that the calculations carried out up to the fifth degree show only the magnitude and the distribution in general. From comparison of the maps it can be seen that the correction by using Hopfner's method has a value 4 to 5 times as great as the correction obtained from the direct application of the isostatic anomalies. Therefore it would be better, even without making corrections, to use the gravity values reduced isostatically.

The corrections must not be neglected, as the undulations which can be expected are smaller and have about the value of the isostatic undulation "U".

By inserting the isostatic undulation in the "Bruns's term" the positive isostatic anomaly found by Vening Meinesz on the oceans may be reduced or even may disappear altogether.

It is shown that in consequence of the isostatic reduction only about 1/13 to 1/30 of the ellipticity of the parallels, as determined by Helmert, Berroth, and Heiskanan, can be explained.--Author's abstract translated by W. Ayvazoglou.

This article is followed by brief notes written by Hopfner and Jung in which the authors defend their points of view on the question.

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2. MAGNETIC METHODS

(126) DIE ERDMAGNETISCHEN BEOBACHTUNGEN DR. W. FILCHNERS AUF SEINER GROSSEN REISE IN CENTRALASIEN IN DEN JAHREN 1926-1928.

(EARTH-MAGNETIC OBSERVATIONS BY DR. W. FILCHNER DURING HIS LONG JOURNEY IN CENTRAL ASIA IN 1926-1928)

By O. Venske

Meteorologische Zeitschrift, vol. 47, No. 11, 1930, pp. 452-453.

In this article Venske reports on the earth-magnetic observations by Dr. W. Filchner during his journey through China and Tibet in 1926-1928.

The material of observations brought back by Filchner is very rich. Eight hundred fifty-eight measurements were made at 145 stations. The number of measurements is almost equally distributed among the earth-magnetic elements (declination, horizontal intensity, and inclination). The observations have proved to be reliable and very useful; they form a valuable material for correction and completion of the existing earth-magnetic maps.--W.Ayvazoglou.

(127) ERGEBNISSE DER ERDMAGNETISCHEN BEOBACHTUNGEN IN SEDDIN IN JAHRE 1929

(RESULTS OF EARTH-MAGNETIC OBSERVATIONS IN SEDDIN IN THE YEAR 1929)

By A. Nippoldt

Meteorologische Zeitschrift, vol. 47, No. 12, 1930, pp. 487-488.

Magnetic observations in Potsdam have been discontinued since 1928, owing to disturbances caused by electrification of the surrounding railway lines. All the measurements will be registered during one year in Seddin, parallel to those in the new observatory in Niemegk. The mounting of variometers in Niemegk was started on August 1, 1930. A table is added showing the monthly and yearly mean values of the magnetic elements for Potsdam and Seddin.

According to the data given the connection between the magnetic activity and the number of sun spots can be established only in general. This connection may be proved by examining the relative figures of the days of disturbance. It has been established that the intensity of the disturbance does not correspond to the size of the spots and that large number of spots may appear without causing great magnetic disturbance.--W. Ayvazoglou.

(128) A MAGNETIC METHOD OF ESTIMATING THE HEIGHT OF SOME BURIED MAGNETIC BODIES

By A. S. Eve

American Institute of Mining and Metallurgical Engineers, Technical Publication 408, 1931, 8 pp.

The author describes tests at the Falconbridge mine as to the

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possibility of estimating the depth to which the pyrrhotite-nickel deposit extended in the earth.

A suggestion was made by Dr. F. W. Lee that this problem might be solved by measuring the vertical magnetic intensity with a good magnetometer, both near the surface of the earth and also at a level a few feet higher in the air. A light wooden platform was made measuring 4 by 4 feet on the top and 10 feet above ground, and readings were taken along a traverse at right angles to the ore body, as well as over a straight magnetic diabase dike, both on the ground and on the platform. According to these readings (given in a table) the magnetic vertical intensity is consistently less at the higher level, which is 10 feet above the lower level. After some mathematical calculations the author concludes that the difference in the readings due to so small a height as 10 feet makes the calculated vertical extent of the dike a highly uncertain quantity, and it is probable that in many cases it may be necessary to have a wooden tower with platforms at 10, 20, and 30 feet above the ground. This seems an elaborate measure, but its cost is trifling compared with drilling, if accurate data can be obtained.--W. Ayvazoglou.

(129) A METHOD FOR DETERMINING MAGNETIC SUSCEPTIBILITY OF CORE SAMPLES

By William M. Barret

American Institute of Mining and Metallurgical Engineers, Technical Publication 394, 1931, 20 pp.

The present method was developed to meet the need for routine analysis of specimens in the geomagnetic laboratory, where it was felt that general utility, ruggedness, ease of manipulation, and reproducibility of results had greater importance than extreme sensitivity.

After discussion of various methods (1, Null method, inductive balance; 2, null method, current balance; 3, semimull method; 4, deflection method, closed circuit; 5, deflection method, open circuit, the author concludes that the utility and accuracy of these methods will depend upon the following:

1. Quality of the equipment.
2. Precise calibration of the component parts of the apparatus.
3. Exact determination of the instrumental constants of the composite arrangement.
4. Manipulative technique of the operator.

A mathematical treatment of the theory and calibration for each method of operation is included. The discussion of the apparatus is accompanied by photographs and performance curves.--W. Ayvazoglou.

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3. SEISMIC METHODS

(130) REPORT ON THE ACTIVITY OF THE EARTHQUAKE RESEARCH INSTITUTE, TOKYO IMPERIAL UNIVERSITY, IN THE FIRST HALF OF 1930.

By Chuji Tsuboi

Gerlands Beiträge zur Geophysik, vol. 28, No. 1-3, 1930, pp. 355-362.

This is the third report published by Tsuboi on the activity of the Earthquake Research Institute in Tokyo (for previous reports see Geophys. Abstracts 10 and 16); it consists of a brief summary of the field and laboratory investigations in the first half of 1930.

Itō earthquakes. The unusual seismic activity during the first half of 1930 caused great interest, and the results of investigations made in connection with this activity are enumerated.

Experimental. (1) R. Takahashi completed construction of a long vertical pendulum seismograph suggested by Prof. H. Nagaoka. The reason for preferring the use of the vertical pendulum is explained. A photograph of the lower part of this seismograph is added. (2) Observations with the Ishimoto tiltometer of the tilting of the surface of the ground have been made in many stations. The results are mentioned. (3) A series of model experiments on the collapse of wooden houses caused by earthquake motions was made by K. Suyehiro.

Geophysical. (1) T. Terada developed a discussion on the nature of destructive earthquakes. He emphasized the desirability of distributing a specially designed seismoscope over the country and of measuring the microscopic gross effects of destruction so as to enable further study of the correlation of their distributions with the seismotectonic structure of the district concerned. (2) C. Tsuboi continued to study deformation of the earth's crust in the Tango district connected with the Tango earthquake of 1927.

Mathematical. (1) K. Sezawa studied free oscillation of an elastic surface layer of a finite thickness which covers a semi-infinite elastic solid. (2) K. Sezawa and G. Nishimura discussed the possibility of the approximately independent movements of land blocks which were pointed out by some of the staffs of the institute actually to have appeared, especially in connection with the Tango earthquake of 1927. (3) G. Nishimura discussed the effect of temperature distribution on the deformation of a semi-infinite elastic body.--W. Ayvazoglou.

(131) BEOBACHTUNGEN ZUR PL-WELLE

(OBSERVATIONS OF THE PL-WAVE

By H. Landsberg

Gerlands Beiträge zur Geophysik, vol. 28, No. 1, 1931, pp. 64-68.

New observations of the PL-wave, discovered by O. Somville (Geophys.

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Abstr. 21, p.9) in diagrams produced by the earthquakes in the central parts of Italy, are given from the records obtained by the Taunus Observatory. This wave has been found also in the diagrams of other earthquakes originating in other southern parts (Messina, Thessaly, Asia Minor) and seems to have appeared even in the case of an Iceland quake.

The time curve, the registering of which was published by Somville, is completed by new observations and is extended as far as 2,500 kilometers.--Author's abstract translated by W. Ayvazoglou.

(132) PROCÉDÉ GRAPHIQUE POUR DÉTERMINÉR L'EPAISSEUR DES ALLUVIONS

(GRAPHICAL METHOD FOR DETERMINING THE THICKNESS OF ALLUVIUM)

By C. Alexanian

In this pamphlet Alexanian describes a graphical method for the determination of the thickness of alluvium by the seismic method. The simple solution may be of use for geologists and geophysicists.--W. Ayvazoglou.

(133) GEOPHYSICAL PROSPECT DEFINITELY PROVED

By Neil Williams

Oil and Gas Journal, vol. 29, No. 38, 1931, p. 44.

The Iowa geophysical prospect of the Calcasieu-Jefferson Davis Parish line, southern Louisiana, was definitely proved as another Gulf coast field. This is the first test drilled on this prospect which was carried out by seismograph exploration in 1929.--W. Ayvazoglou.

(134) PROVE ANOTHER GEOPHYSICAL PROSPECT

By Neil Williams

Oil and Gas Journal, vol. 29, No. 39, 1931, p. 50.

Test in Plaquemines Parish, extreme southeastern tip of Louisiana, has proved another geophysical dome. It is in a cavity in what is believed to be cap rock at 2,216 feet. This dome was located by seismograph during 1928. Geophysical findings during 1928 had indicated that dome material, cap rock or salt, would be found between 2,000 and 2,500 feet.--W. Ayvazoglou.

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4. ELECTRICAL METHODS

(135) MEASUREMENTS OF RESISTIVITY BY CENTRAL ELECTRODE METHOD AT ABANA MINE, NORTHWESTERN QUEBEC, CANADA

By Lachlan Gilchrist

American Institute of Mining and Metallurgical Engineers, Technical Publication 386, 1931, 17 pp.

At the Abana mine, northwestern Quebec, there is a porphyritic quartz diabase dike about 225 feet wide and extending north-south; the location has been determined in general outline by means of a dip needle or magnetometer.

This dike has an overburden of glacial drift 75 to 200 feet thick. Adjacent to the dike on the western side is an ore body of pyrite and chalcopyrite and sphalerite of low resistivity and on the eastern side is another ore body of considerably higher resistivity. A central-current electrode was placed at points above the dike, and end-current electrodes were placed at points about 1,000 feet east and 1,000 feet west of the central electrode. Electrodes for potential measurements were placed 50 feet apart along lines running north and south through the central-current electrode stations.

With this layout measurements of resistivity at successive distances from the central electrodes were made. From interpretation of the results an approximate determination of the depth of the overburden and a fairly accurate determination of the location of the ore bodies could be made.--Abstract reprinted from Mining and Metallurgy, vol. 12, No. 20, February, 1931.

(136) MATHEMATICAL THEORY OF ELECTRICAL FLOW IN STRATIFIED MEDIA WITH HORIZONTAL, HOMOGENEOUS, AND ISOTROPIC LAYERS

By D. O. Ehrenburg and R. J. Watson

American Institute of Mining and Metallurgical Engineers, Technical Publication 400, 1931, 18 pp.

Making use of a generalized method of images the authors have obtained a solution for the electrical flow in a stratified medium with horizontal, homogeneous, and isotropic layers. This solution can be used for any number of layers of any thickness and of any resistivity. Theoretically, the generalized method of images is applicable to any number of layers. However, in practice it will be found that in the case of a more than 3-layer earth this method becomes quite awkward. The method presented here is analytical, although certain principles of the image theory are utilized indirectly in building the tentative solution. The differential equations finally lead to a set of algebraic equations; these result in formulas which can be arrangod in a rather simole form, so that particular solutions for arbitrary cases may be built up and carried out numerically by one unfamiliar with both the methods of images and the calculus. Six calculated curves are included which show the percentage anomaly of resistivity for a 2-layer, 3-layer, and 4-layer earth, using fixed-current electrodes and moving-potential electrodes.--Abstract reprinted from Mining and Metallurgy, vol. 12, No. 290, 1931.

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(137) ELECTRICAL EXPLORATION APPLIED TO GEOLOGICAL PROBLEMS IN CIVIL ENGINEERING

By E. G. Leonardon

American Institute of Mining and Metallurgical Engineers, Technical Publication 407, 1931, 17 pp.

In this paper Leonardon describes the practical results obtained in several problems of civil engineering by resistivity measurements of the underground. The theoretical and technical sides of the process employed are not discussed, and only a few general points are mentioned to make clear the practical examples given.

The practical examples discussed are the following:

1. Exploration at Bridge River Tunnel.

2. Exploration on the St. Lawrence River near Morrisbury, Ontario, Canada.

3. Survey on the Lièvre River near Masson, Quebec, Canada.

From these practical examples (illustrated by figures) the author shows how the resistivity measurements of the underground can supplement efficaciously the geological information in the study of certain engineering projects.

The advantages of the electrical method for carrying out structural studies are its rapidity and economy, which makes it particularly valuable in preliminary surveys where a general outline of the underground conditions is required immediately.

The author demonstrates the rapidity and economy of the process by the following figures: The survey at Bridge River required only four working days; the works at Morrisbury and Masson were performed in 30 and 33 1/2 working days respectively. During the course of these last two explorations, 176 depth determinations were made, which cost the companies about $10,000.

A close cooperation between the geologist and geophysicist is required for obtaining the most complete and satisfactory results.—W. Ayvazoglou.

(138) ELEKTRISCHE BOHRKERNBESTIMMUNG

(ELECTRICAL DETERMINATION OF CORES)

By C. and M. Schlumberger

Internationale Zeitschrift fuer Bohrtechnik, Erdölbergbau, und Geologie, vol. 38, No. 1, 1930, pp. 1-8.

This is a translation of the lecture delivered by C. Schlumberger at the Second International Drilling Congress in Paris. The article was published

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in Mining and Metallurgy, vol. 10, No. 275, 1929, pp. 515-518 under the title, "Electrical Log and Correlations in Drill Holes." (See Geophys. Abstr. 20, Dec., 1930, pp. 14-15).--W. Ayvazoglou.

5. RADIOACTIVE METHODS

(139) COMPARISON OF SCHWEIDLER'S TWO METHODS FOR DETERMINING AVERAGE LIFE OF SMALL IONS IN AIR

By Cilian O'Brolchain

Gerlands Beiträge zur Geophysik, vol. 29, No. 1, 1931, pp. 1-21.

Contents of the article:

Part I Introduction.

Part II Description of Schweidler's methods I and II.

Part III Description of apparatus and experimental details.

Part IV Results (the results of the 33 experiments made are shown in a table).

The following summary is given by the author:

The two methods proposed by Prof. Schweidler for the determination of β', the diminution constant of small ions in the presence of nuclei and large ions (and the reciprocal of β' i.e., τ, the average life of the small ions) are discussed. The correction for diffusion in method I is shown to be important.

The investigation of the values given by the two methods when applied to the same air is described. It is found that the values differ considerably. The value of the ratio β'_{II} / β'_{I} is always greater than unity, where β'_{II} and β'_{I} denote the values of β' obtained by methods II and I respectively. The mean value of this ratio is about 2.

There are considerable variations in the value of the ratio obtained in different experiments. No dependence of the value of the ratio on the absolute value of β'_{II} or of β'_{I} could be found. Likewise, no dependence could be found on the value of q, the rate of production of ions in the ionization chamber.

The mean value of the ratio n_+/n_-, where n_+ and n_- denote the number of positive and negative small ions per cubic centimeter in the air of the ionization chamber, was found to be 1.20.--W. Ayvazoglou.

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(140) THE NATURE AND MOBILITY OF AIR IONS (IN RUSSIAN)

By Z. F. Valta

Journal of Geophysics and Meteorology, Leningrad,
vol. 6, No. 3, 1929, pp. 195-215.

In the first part of the article the author gives a concise exposition of the results of the investigations on the nature and the mobility of ions made by a series of scientists. Values for the mobility of ions and curves showing their mobility under various conditions are given.

The second part deals with the new methods of determination of the mobility, the idea of which belongs to W. J. Altberg, but some essential improvements were added by the author in constructing the apparatus.

A picture of the apparatus, which consists of a cylindrical condensator of Zeleny's type, and a detailed description thereof are given.

The advantages of the apparatus improved by the author as compared with that constructed by Zeleny are summarized as follows:

1. There is a possibility of measuring young ions, up to 10^{-4} seconds of age.
2. The place of ionization is strictly determined.
3. The field inside of the condenser remains homogeneous.
4. The distribution of ions is not distorted.
5. All the data necessary for the determination of the mobility are easily determined.

The dependence of the mobility of positive ions on their age has been measured with the aid of this apparatus, and curves have been drawn showing the smaller the age of the ions the greater their mobility. By drying the air current which passes through the apparatus by means of calcium chloride ($CaCl_2$) or phosphoric anhydride (P_2O_3), and by freezing it by means of liquid air, increased values of mobility were obtained.--W. Ayvazoglou.

6. GEOTHERMAL METHODS

(141) GEOTHERMAL PHENOMENA AND GEOLOGICAL HISTORY WITH SPECIAL REFERENCE TO OLD STRUCTURES IN GEOTHERMAL EQUILIBRIUM

By M. W. Strong

Journal of the Institution of Petroleum Technologists,
vol. 16, No. 86, 1930, pp. 889-901.

Geothermal phenomena are discussed in this article under the following headings:

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1. Introduction. Thermal conditions to be expected in old structures are considered first. Investigation is continuing with reference to these conditions in young structures where thermal changes may be expected to be still continuing.

2. Some factors affecting geothermal distribution. The conductivity of the rocks and of their fluid contents are the dominant factors determining the thermal conditions. Topographic irregularities must also be taken into consideration. Effects due to the underground movement of water, oil, and gas must be analyzed specifically in each case in which they arise.

3. Conductivities of rocks. Approximate conductivity of various rocks and substances is given.

4. Influence of thermal conductivity on strata on isogeotherms. The distribution of heat in and around masses of relatively good and bad thermal conductivity placed in a medium through which heat is flowing is examined by the aid of some diagrams.

5. Buried hills or anticlinal structures. These are considered on the supposition in each instance that the structure is old enough for geothermal equilibrium to have been attained.

6. Faults and unconformities. The distribution of isogeotherms in the neighborhood of a fault which has thrown badly conducting strata against strata of higher conductivity is considered.

7. Buried faults and unconformities. The thermal distribution above a buried fault by which beds of different conductivities have been brought into contact, the whole lying buried beneath a thick overburden, is considered.

8. Importance of conductivity determination. Determination of the conductivities of the beds should be one of the first objectives of a geothermal survey, as they are the controlling factors determining the geothermal distribution.

9. Note on topography and isogeotherms. The static distribution of temperature under hills is illustrated in a figure. It is shown by the diagrams that in homogeneous horizontal strata topographic irregularities alone would give rise to irregularities of the isothermal contours.

10. Factor for elevation with respect to sea level. The necessity of measuring the mean surface temperature is mentioned.

11. Influence of dip on conductivity. In some sandstones, especially if micaceous, and in slates and some laminated shales, the conductivity perpendicular to the cleavage may be only about half that parallel to the cleavage, so that in some districts allowance must be made for this additional factor.

12. Some general remarks on static thermal fields are given.

13. Presentation of geothermal data. It is evident that for the elucidation of geothermal data the data must be presented in the form of isogeotherm

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drawn on a geological section, together with information regarding the lithology of the several beds.

14. Gradients and their significance. Wide variations in the values of gradients assembled from temperature measurements in boreholes show the necessity of studying their significance.

15. Applications of geothermal methods to the study of old structures. Detailed application of diagrams showing the kinds of thermal fields to be expected must be worked out in each district separately, having regard to local structural and lithological conditions, and no general rules can be given for their use.

The author concludes that with regard to locating oil sands in a given structure by means of temperature there are at present insufficient data on the conductivity of oil-bearing beds in comparison with the conductivity of the same beds when water logged or barren, and until these experimental data come to hand geothermal data must be regarded as of use only in so far as they are indicative of structure.--W. Ayvazoglou.

(142) GEOTHERMIC GRADIENTS

By J. G. Finlay

South African Mining and Engineering Journal,
vol. 41, Part II, No. 2051, 1931, pp. 509-510.

The following brief description of Dr. Haldane's "Calorometer" suggested for obtaining a standardized method of measuring rock temperatures is given:

> The calorometer consists essentially of a brass tube about 1 inch in diameter, containing a glass tube about half-inch in diameter. The space between the glass and brass tubes is packed with dry felt, and the bottom and top of the tube is secured as shown in the sketch. The glass tube is filled with distilled water, a rubber plug is inserted, and the apparatus closed by means of a brass cap. The calorometer is then placed in a bore hole and kept there for say 18 to 24 hours, when it is quickly withdrawn, unscrewed, and the temperature of the water taken.

An average of over several hundred observations in Europe and America gives what may be called a normal geothermic of approximately 1° F. per 72 feet descent.

Great departures from this normal figure (Comstock Lode in Nevada, 1° F. for every 33 feet descent; Lake Superior copper mines, 1° F. per 250 feet descent) led to the conclusion that the geothermic gradient is influenced mainly by the following factors:

(a) Lithological character of strata. According to investigations by Dr. Pirow it was found that the temperature gradient was steeper in the shales

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than in the quartzites and that, generally speaking, the gradient was approximately proportional to the mean conductivity of the rocks. The following table shows conductivity, as given in the British Association Report:

Rock	Conductivity, calories/cm. per sec.
Granite	0.0055
Basalt	.0055
Quartzites	.0095
Slate	.0030
Shales	.0020
Gneiss	.0051

(b) Active chemical processes of decomposition. Under such circumstances the gradient tends to become steeper.

(c) Relief of strata. It has been demonstrated on several occasions that when observations are taken on high ridges and mountains the gradient is much flatter.

(d) Presence of large bodies of cool water, adjacent to the strata. This factor serves to demonstrate the cooling effect of a large body of water (5 miles from the Lake Superior copper mines the gradient is 1° F. per 95 feet; close to the lake, only 1° F. per 250 feet).

The author concludes that in any part where observations are taken there are many conflicting factors which have to be considered, and the difficulties attendant on arriving at any definite conclusions will be obvious.--W. Ayvazoglou.

7. UNCLASSIFIED METHODS

(143) NEUNTE TAGUNG DER DEUTSCHEN GEOPHYSIKALISCHEN GESELLSCHAFT

(NINTH SESSION OF THE GERMAN GEOPHYSICAL UNION)

By A. Nippoldt

Die Naturwissenschaften, vol. 18, No. 43, 1930, pp. 893-894.

This session was held in Potsdam from September 11 to 14, 1930. The session was characterized by a series of lectures concerning the relation of geophysics to other sciences. A brief account of the following lectures is given:

1. On the examination of Störmer's theory of the sun corona, according to investigations made by E. v.d. Pahlen and A. Kohlschütter, delivered by A. Nippoldt.

2. On the close connection between earth-magnetic disturbances and disturbances in radio-telegraphy receiption, by Dr. Mögel.

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3. On the present conditions of investigations upon penetrating radiation (Höhenstrahlung), by W. Kohlhörster.

4. On the researches concerning lightning phenomenon based on observations made in various places, by Dr. A. Mathias.

5. On the seismic investigations on the Pasterze glacier, by Dr. Mothes and Dr. Brockamp.

6. On seismic investigations by explosions, by Dr. G. Angenheister.

7. On the theory of globular waves, by K. Uller.

8. On the cooperation of geology and geophysics, by R. Schwinner.

9. On the application of technical rupture experiments to geology, by E. Seidel.

10. On the sidereal-day variation of the earth magnetism, by Ad. Schmidt.

11. On the investigation of heavy ions in the atmosphere, by H. Israel.

12. New instruments for pendulum measurements, invented by and introduced by O. Meisser, H. Martin, and Th. Gengler.

13. New instruments for statical measurement of earth-gravity, invented by O. Hecker and H. Haalck and explained by them.

14. Dependence of the gravitational effect on the intermediate layers, by T. Schlomka.

All the lectures were followed by discussion.--W. Ayvazoglou.

(144) GEOPHYSICAL INVESTIGATIONS FOR THE NORTHERN TRANSVAAL (MESSINA) COPPER EXPLORATION CO.

Editorial note

Mining and Industrial Magazine of Southern Africa, vol. 11, No. 9, 1930, p. 353.

At the annual general meeting of this company the chairman referred to the importance of geophysical prospecting and intimated that the results obtained on the property of the company after many months of investigation were highly successful and point to the location of several large mineral-bearing zones of copper ore.--W. Ayvazoglou.

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(145) GEOPHYSICAL EXPERIMENTAL SURVEY

Editorial note

Industrial Australian and Mining Standard,
vol. 84, No. 2173, 1931, p. 434.

The brief report of the confirmatory work of the States Departments on the geophysical experimental survey carried out during two years and completed in 1930 notices the following results:

In Queensland three bores put down at Mungana have resulted in the location of one probably small low-grade copper-bearing deposit.

In Victoria, where most of the work done was carried out by gravitational methods, forecasts of the section concerned in regard to delineation of the extent underground of a brown-coal deposit at Gelliondale have been fully confirmed by five critical bores.

In Tasmania the existence of two previously unknown copper-nickel lodes has been fully proved by costeaning; the precise position of a continuation of a pyrrhotite lode in the Renison Bell district has also been confirmed by three bores.

In South Australia a previously unknown deposit of graphite has been proved by means of a drive put out from an existing shaft.

The full report will be published by the Cambridge University Press and probably will be available early in 1931.--W. Ayvazoglou.

(146) GEOPHYSICAL PROSPECTING RESULTS IN TASMANIA AND SOUTH AUSTRALIA

Editorial note

Chemical Engineering and Mining Review,
vol. 23, No. 267, p. 101, Dec. 5, 1930.

In this article a brief report on the results of geophysical exploration by the Imperial Geophysical Experimental survey is given. Methods used for exploration are not mentioned. Several favorable zones and areas were indicated in both Tasmania and South Australia.--W. Ayvazoglou.

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9. NEW BOOKS

(147) Bartels, J. Geophysikalischer Nachweis von Veränderungen der Sonnenstrahlung (Geophysical indication on the changes of the sunshine rays). Special reprint from volume 9 of the "Ergebnisse der exakten Naturwissenschaften," issued by "Naturwissenschaften." Julius Springer, Berlin, 1930. The price of the complete volume, R.M. 28; bound, R.M. 29.40. Deals with the connection of meteorological and earth-magnetic phenomena with the sclar variations.

(148) Meteorological Office, London. The Meteorological Glossary, 1930. 233 pages. The book can be obtained from His Majesty's Stationery Office, Adastral House, Kingsway, London, W.C. 2. Price, 4 s. 6 d. The book contains an appendix in which a translation of more than 300 technical expressions into Danish, Dutch, French, German, Italian, Norwegian, Portugese, Spanish, and Swedish is given.

(149) Physics of the Earth -- II. The Figure of the Earth. Bulletin of the National Research Council, February, 1931, No. 78. 286 p. Cloth $3.50; paper $3.00. Published by the National Research Council of the National Academy of Sciences, Washington, D. C. This is a collection of short papers, written by leading scientific men in several branches of geophysics, and treating on the size and shape of the earth. Contents of the book:

Tides, Ocean and Earth.

Chapter I, Introduction. G. T. Rude, pp. 3-18, 5 figures.

Chapter II, Tidal theory. A. T. Doodson, pp. 19-39; 4 figures.

Chapter III, Tidal computations and predictions. Paul Schureman, pp. 40-49.

Chapter IV, Mean sea level. H. A. Marmer, pp. 50-67; 6 figures.

Chapter V, Earth tides. W. D. Lambert; pp. 68-80.

Chapter VI, Tidal friction. W. D. Lambert, pp. 81-99; 3 figures.

Gravity, Deflection of the Vertical, and Isostasy.

Chapter VII, Isostasy. William Bowie, pp. 103-115.

Chapter VIII, The influence of isostasy on geological thought. Harry Fielding Reid; pp. 116-122.

Chapter IX, The shape and size of the earth. W. D. Lambert, pp. 123-150; one figure.

Chapter X, Determination of "g" by means of the free-swinging pendulum. C. H. Swick, pp. 151-166; 2 figures.

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Chapter XI, Gravity measurements with the Eötvös torsion balance. Donald C. Barton, pp. 167-190; 3 figures.

Chapter XII, Geodetic instruments. D. L. Parkhurst, pp. 191-200.

Chapter XIII, On some of the greater problems of physical geology. Clarence L. Dutton, pp. 201-211.

Chapter XIV, The determination of elevations. H. G. Avers, pp. 212-220.

Chapter XV, The determination of geographic positions. C. V. Hodgson, pp. 221-242; 8 figures.

Variation of Latitude.

Chapter XVI, The variation of latitude. W. D. Lambert, Frank Schlesinger, E. W. Brown, pp. 245-277; 9 figures.

Index, pp. 279-286.

Each chapter is supplied with references. In the foreword of this book the necessity is mentioned of preparing a series of bulletins on the physics of the earth, the purpose being to give to the reader, presumably a scientist but not a specialist in the subject, an idea of its present status together with a forward-looking summary of its outstanding problems.

The volumes will appear serially in the bulletin series of the National Research Council, with no particular regard to sequence, each volume being issued when ready.

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10. PATENTS

1. GRAVITATIONAL METHODS

(150) METHOD AND APPARATUS FOR DETERMINING GRAVITY VARIATIONS

Harvey C. Hayes,
of Washington, District of Columbia.

1,787,536 Patented Jan. 6, 1931.

This invention has particular reference to determination of the variations in the gravity constant in its relation to geophysical exploration work.

The present invention contemplates a new and improved method which overcomes to a large extent the objectionable feature of the previously known methods and apparatus. The patent discloses the use of a plurality of simple pendulums to be set up at a series of points over an area to be explored and to be operated simultaneously, with provisions for forming a common photographic record of the number of oscillations of all of the pendulums.

Claims allowed - 12.

(151) APPARATUS FOR TAKING GEOPHYSICAL MEASUREMENTS BY MEANS OF ROTATABLE BALANCE

Willy Paul Jenny, of Strasburg, Ohio, Assignor
to the firm Exploration G.m.B.H. of Hanover, Germany.

1,791,413 Patented Feb. 3, 1931.

The present invention relates to the Eötvös balances and consists of an adjustable stand for such a balance, with means for raising a base plate supporting the balance to the upmost measuring position, where the base plate is rotated automatically, and for sinking the plate afterward and rotating it automatically in one or more lower measuring stations.

Claims allowed - 3.

(152) APPARATUS FOR DETERMINING FORCE OF GRAVITY AT SEA

Harvey C. Hayes, of Washington, District of Columbia.

1,792,013 Patented Feb. 10, 1931.

The primary object of the present invention is to improve and simplify the methods now commonly employed for determination of the "gravitational constant" (g) and more specifically to provide suitable apparatus for carrying out the method at sea, and to devise a suitable gravity pendulum which will not be affected by the rolling and pitching movement of a vessel at sea.

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It is proposed to eliminate the necessity for an accurate chronometer by the employment of two pendulums in proximity to each other, the one pendulum being of a type termed "standard," which is unaffected by the variations in the force of gravity, while the second pendulum is of a type distinctly affected by such variations in the force of gravity.

Claims allowed - 9.

2. MAGNETIC METHODS

(153) METHOD OF AND APPARATUS FOR DETERMINING DIRECTION OF DIP AND STRIKE OF EARTH'S SUBSTRATA

Henry N. Herrick, of Berkeley, California, Assignor to Standard Oil Company of California, San Francisco, California, a Corporation of Delaware.

1,792,639 Patented Feb. 17, 1931.

This invention relates to a method and apparatus for determining the direction of the dip and strike of the earth's substrata, more particularly, to determination of the magnetic properties of a sample taken from the strata of which the direction of the dip and strike are to be ascertained.

An important object of the present invention is simplicity and reliability of methods and apparatus for determining the dip and strike of the earth's substrata from a single borehole.

Claims allowed - 3.

3. SEISMIC METHODS

(154) SEISMOGRAPH AND APPLICABLE TO OTHER MEASURING INSTRUMENTS

John Hugh Jones, of Hastings, England

1,774,379 Patented Aug. 26, 1930.

This invention relates to means for indicating or recording small displacements.

According to the invention the small displacements to be magnified are imparted to a magnetic element--for example, a thin iron strip of suitable shape--held suspended in a direction transverse to a rapidly distorting magnetic field, that is to say, a magnetic field the value of which changes appreciably from point to point, so that the lines of magnetic force are strongly curved. The arrangment is such that the suspended elements will take up a position parallel or nearly parallel to the tangent to the line of force at any particular point, and thus if a small mirror is attached to the suspended element and the suspended element and the source of the field are moved relatively to one another there will be a rotation of the mirror

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proportional to the displacement of the suspended element, provided this displacement is small. Small displacements of the suspended element otherwise indiscernible may thus be indicated or recorded.

The means described may be employed to record small earth movements imparted to a pendulum or seismograph of either the horizontal or vertical type. It also may be employed in connection with a balance.

Claims allowed - 4.

(155) SYSTEM AND METHOD FOR GEOPHYSICAL EXPLORATION

Frank Rieber, of San Francisco, Calif.

1,782,445 Patented Nov. 25, 1930.

The objects of the invention are (1) to make it possible to obtain readily interpretable data from artificially produced shocks; (2) to make it possible to secure complete data with relatively few detonations; (3) to provide a system for geophysical explorations, which yields extreme accuracy; and (4) to provide such a system, the operation of which is affected by a minimum number of uncontrollable factors that enter into the plotting of the results obtained. The means for the accomplishment of the objects are explained.

Claims allowed - 3.

(156) METHOD FOR MAKING SUBTERRANEAN SURVEYS

Harvey C. Hayes, of Washington, District of Columbia

1,784,439 Patented Dec. 9, 1930.

The present invention is based upon the phenomenon of variation in the coefficients of absorption and reflection in accordance with the frequencies of the waves transmitted, as well as the media of transmission of reflection.

Claims allowed - 9.

(157) SEISMOMETER

Henry G. Taylor, of Beaumont, Texas, Assignor to Geophysical Exploration Company, of Beaumont, Texas, a corporation of Delaware.

1,789,055 Patented Jan. 13, 1931.

One of the outstanding aims of the invention is to provide a novel thread suspension for the free end of the inertia mass, which suspension makes possible the conversion of the vertical motion of the inertia mass into a rotary motion so as to make such motion more readily adaptable to registration on a photographic film by means of a ray of light.

Claims allowed - 36.

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(158) METHOD OF SEISMOLOGICAL RESEARCH

Austin N. Stanton, of Iowa City, Iowa.

1,790,080 Patented Jan. 27, 1931.

Patent discloses improvements in a method of seismological research by which the depth is calculated directly from the frequency. The method involves a device, which is called a "geo-oscillator", to create, periodically, a strong pressure on the surface of the earth, the frequency of which can be varied from time to time; and a resonance indicator which records the consequent movement of the earth's surface at the same or a nearby point.

Claims allowed - 7.

(159) ELECTRICAL RECORDING SEISMOGRAPH

By Hugo Benioff

Pasadena, California, Assignor to Carnegie Institution of Washington, of Washington, District of Columbia, a Corporation.

1,784,415 Patented Dec. 9, 1930.

The object of this invention is to provide a seismograph whose response shall provide a measure of or be proportional to the kinetic energy of the earth particles or to that due to both the positive and negative velocities of the earth particles; another object is to provide the necessary damping of the seismometer pendulum by properly proportioning the strength of the main field and the resistance of the circuit, whereby additional damping means are unnecessary.

Claims allowed - 4.

4. ELECTRICAL METHODS

(160) ELECTRICAL PROSPECTING

By Emil Edward Mueser

Mountain Lanes, New Jersey

1,791,933 Patented Feb. 10, 193

The object of this invention is to overcome the effect of undesirabl magnetic fields set up by the flow of currents through the generator or other supply of electrical energy and through the leads connecting the generator to the electrodes and through other apparatus associated with that part of the sy tem which supplies the current to the earth.

This patent discloses how this undesirable magnetic field may be

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confined to close proximity with the apparatus or connecting wires in which it is produced by covering the apparatus and connecting wires with metallic shielding of high permeability and conductivity.

Claims allowed - 2.

(161) METHOD AND APPARATUS FOR LOCATING CONDUCTIVE BODIES

By John J. Jakosky

Los Angeles, California, Assignor to the Radiore Company, of Los Angeles, California.

1,792,910 Patented Feb. 17, 1931.

This patent discloses means for the employment of a transmitting or energizing apparatus which is adapted to set up an electromagnetic field at points below the earth's surface which is much more intense than that created at equal depths by any of the transmitting means heretofore employed, for the same power consumption and approximate size and cost of equipment.

Claims allowed - 8.

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3 - The first figure refers to the number of the abstract, the second to the method of prospecting as indicated in the Table of Contents, and the third to the page.

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